

three or four feet of wing—who will swoop and take meat from a basket on a man's head, any day, or even from his hand. A score or two of these circling about the kitchen and outhouses, may be watched with advantage from the house-top, as is evident. The difficulty is to reproduce, in description, anything definite, from the copiousness of the evidence. I can therefore only express distinctly the conclusions I formed:—(1) that it was utterly incomprehensible; (2) that there *must* be some unperceived source of motion; (3) that it *might* be (and probably was), a subtle utilisation of the varying air currents met with or sought for. This conclusion lands one in a new set of perplexities, it is true; but it is the least opposed to reason, however ill it may accord with some of the facts as interpreted by us.

Vultures are large heavy brutes, with comparatively little wing-power, and their flight is far slower and heavier. They very commonly rest on the ground, doing nothing, and if disturbed, the effort to rise is evidently a toilsome one. Nevertheless, they too possess, and largely exercise the power, of sustaining themselves in mid-air without apparent *action*. Not that they ever rest motionless, but they sweep about in endless paths with hardly ever a beat of the wing except on occasion, in this respect seeming to husband their strength much more than the kites, who are always on the move, and wheel in much sharper curves.

I was a good deal impressed, at one time, with the notion that the secret lay in slants of wind taken advantage of, but the more I see the less I like it. It is impossible to conceive upward currents as commonly strong enough to support a *dead* bird similarly extended. And though I am not prepared to assert that I have ever seen birds floating motionless where there was *no* wind, yet if we are to take the vertically resolved portion of wind, considered as essential, as the supporting agency, what becomes of the horizontal force? Given a sufficient momentum, one could conceive an economic expenditure of it, but not enough to explain the endless wheelings of vultures, much less the long continued poising without forward or backward movement of eagles.

In fine, I can only echo Mr. Guthrie's appeal for further explanation; but I beg that we may have no nonsense about "bones filled with air." One is tempted to ask in that case if death *solidifies* the bones, to account for the undeniable weight and density of a goose.

J. HERSCHEL

Bangalore, July 6

Earthquakes in the Samoan Islands, South Pacific

ON two former occasions I have contributed to NATURE notices of the earthquakes experienced in these islands. I will now continue my list from the commencement of 1872.

On March 22, at 1.25 P.M., there was a shock from N.E., motion horizontal. Vibration continued 15 seconds. For several seconds before the motion was felt, and during the whole time of vibration, there was a noise like distant thunder.

On April 8, at 3.10 P.M., there was a slight shock, horizontal.

May 11, at 10.20 A.M., we had a double shock. This was rather severe. Motion horizontal; interval between shocks, 15 seconds; total duration, 25 seconds.

May 28, at 10.30 P.M., a slight horizontal shock.

Sept. 9, at 10.20 P.M., double, horizontal shock from N.E.; interval 125 seconds. This was a more severe shock than we usually feel here.

Nov. 12, at 5.10 A.M., a slight horizontal shock.

Dec. 3, at 9.20 P.M., a slight horizontal shock.

Jan. 2, 1873, at 7.40 A.M., a shock which, in these islands, is considered very severe. The motion was horizontal. The main undulation was followed by rapid oscillations for 45 seconds, followed by a sea-wave.

I regret that I cannot give full and definite information respecting this earthquake. I was away from home at the time, staying at the inland residence of the British Consul, on the island of Upolu, where I was unable to note with precision any of the accompanying phenomena. The Consul's residence is a wooden building with a ground floor only. It stands due east and west. This shook very severely with the rapid undulations of the earth-waves, apparently, longitudinally from east to west. I at once thought the centre of impulse was to the east of my position. Of this, however, I am by no means certain; in fact, I have reason to doubt whether my observation on this point was correct. The sea-wave was almost entirely confined to the south coast of the islands of Upolu and Saraii. On the island of Tutuila (forty miles to the east of Upolu) it rose equally on the

south and north sides. I have at present no information from Manua (three islands about sixty miles east of Tutuila) except that both earthquake and sea-wave were felt there. None of those who saw the sea-wave noticed particularly the time which elapsed between the earthquake and the rolling inland of the sea-wave. All my informants from Saraii (the most westerly island) agree that the one followed the other almost immediately. They felt the earthquake and almost immediately afterwards saw the reef bare much lower than it is at low tide. The tide was at about half-ebb at the time. Following closely on this efflux came the reflux in a large wave which rolled inland and flooded the sites of villages lying low at the back of deep bays. This wave rose about 6 ft. above high-water mark during spring tides. The rise and fall during spring tides in this group being about 4 ft. 6 in. The first great wave was followed by a number of smaller waves, and the oscillation continued for some time. No efflux of the sea was noticed, as far as I can learn, on Upolu or Tutuila. At the latter island the sea-wave rolled inland more than half-an-hour after the earthquake, and rose about 6 ft. above high-water mark. No damage of importance was done by the wave.

Two days after the above earthquakes, we had three others in rapid succession, and three more have followed them on different days since, viz. :—

On Jan. 4, at 10.45 A.M., we had a heavy horizontal shock, or rather a succession of shocks, two of which were severe. These continued 55 seconds, and were accompanied by great rumbling and a hissing noise.

Four minutes afterwards, viz., at 10.50 A.M., we experienced another sharp shock, accompanied by similar noises. The vibrations of this shock continued 15 seconds. We had scarcely recovered our equilibrium and quieted our nerves after this second shock when, at 10.57 A.M., we were startled by another, the oscillations of which lasted 20 seconds. This also was accompanied by great rumbling.

No damage was done by these earthquakes. The buildings in these islands are all low, and nearly all are built with wood, so that only a very severe earthquake could do much injury.

On Jan. 8-9, at midnight, another slight horizontal shock was felt.

On Jan. 13, at 8.45 A.M., we had another which was also slight.

On Jan. 14, at 5.24 A.M., there was another slight horizontal shock.

The Samoan Islands owe their existence to volcanoes, as they consist almost entirely of volcanic rock. There has, however, been no eruption for a very long period until in 1867, when, it will be remembered, a submarine volcano burst out between Ta'u and Olosenga, two of the Manua islands in the eastern end of the archipelago. This subsided after a fortnight's activity. A few months afterwards I was on board H.M.S. *Falcon* when soundings were taken over the spot where the volcano had been. We found a cone 180 feet above the bed of the surrounding ocean: the average depth of the sea around it being 120 fathoms, while the depth on the apex of the cone was only 90 fathoms. There has been no further eruption from this volcano up to the present time. Almost ever since this has been quiet, there has been great activity in the volcano of Nina Foou, in the neighbourhood of the Friendly group of islands.

Samoa, S. Pacific

S. J. WHITMEE

THE ARITHMOMETER

MOST of our readers who have anything to do with calculations have heard of the above calculating machine, the invention of M. Thomas de Colmar. A few remarks, therefore, on its construction and operation may be of interest to those who have not seen this really useful calculating machine.

The instrument is of small size, the one which we are about to describe being only 22 in. long, 6½ in. wide, and 3½ in. deep.

We can best give an idea of the great saving of time effected by this instrument when we state that with it eight figures (tens of millions) can be multiplied by eight figures in eighteen seconds, sixteen figures be divided by eight figures in twenty seconds, and a square root of sixteen figures be extracted, with the proof, in less than two minutes.

Our illustration shows a top view of an arithmometer

the lid of the box being removed. It is constructed chiefly of a brass plate, A, furnished with eight slots, as shown; directly under these slots are mounted eight drums, each having nine elongated cog teeth of successively decreasing length; over each drum, and between it and the slot, is mounted a square shaft, on which slides a pinion wheel so as to catch any number of teeth on the drum. Each of these pinion wheels is moved by a button, *a*, of which there is one in each slot, the figures at the sides of the slots showing the proper position of each button *a*, for any work to be performed by the instrument.

The cogged drums gear by bevil wheels with a long horizontal shaft, which is also in gear with the vertical shaft moved by the handle *b*, by which the instrument is worked. B is a moveable brass plate, which can turn and slide on a round bar-hinge at the back; in this plate there are sixteen holes, *c*, under each of which is a moveable disc numbered from 0 to 9, and arranged so that any one figure of each disc may be brought under its corresponding hole *c*. These discs have bevil wheels which gear with bevil wheels on the before-mentioned square shafts. The moveable plate B is also furnished with the holes *d*, having discs numbered from 0 to 9 underneath, and are for showing the number of turns of the handle, giving by this means the quotient in division, and showing the multiplier in multiplication. The knobs C and D are for bringing the figures under the holes *c* and *d* to zero before

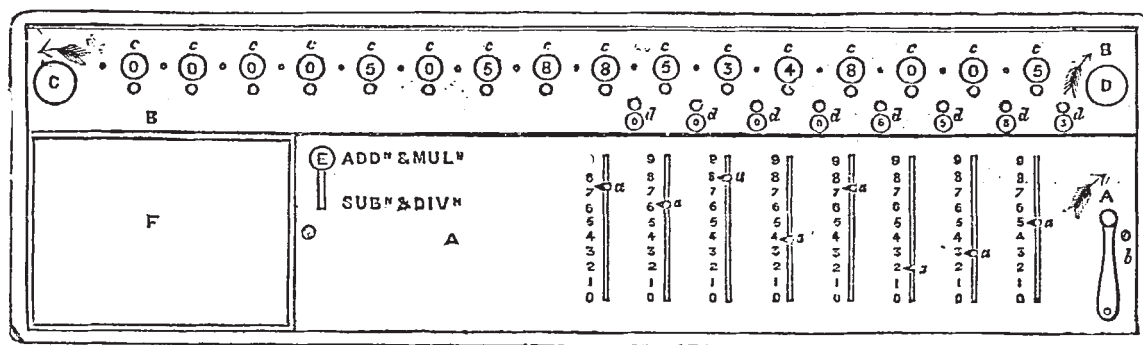
commencing an operation, and the knob E is for setting the instrument to work addition and multiplication, or subtraction and division. F is a small slate for memoranda.

Before further describing the working of the machine, we would remark that, if the knob E be placed at Addⁿ, each turn of the handle will carry the figures marked by the buttons *a*, under the indicator-holes *c*, or add them to the figures already under the holes *c*, while if the knob be placed at Subⁿ, each turn of the handle will subtract from the figures under the holes *c*, the numbers marked by the buttons *a*.

Such being the general construction and principle of the machine, we will now proceed to give an example of its operation for multiplication, the operations for addition and subtraction being sufficiently explained in the preceding paragraph.

Thus, to multiply 76847235
by 6583

Mark the multiplicand on the plate A by the buttons *a*, as shown in the illustration; set the knob E at Addⁿ and Mulpⁿ, then turn the handle *b* three times for the unit figure of the multiplier, and three times the multiplicand, viz. 230541705, will appear under the holes *c* in the moveable plate B; this plate must now be raised, and moved one figure or station to the right, and the handle turned eight times for the second figure of the multiplier, and



Colmar's Arithmometer

63783205 will appear under the holes *c*; move the plate B again to the right, and turn the handle five times for the third figure of the multiplier, and 44801938005 will be brought under the holes *c*; and finally, by moving the plate B once more to the right, and turning the handle six times for the last figure of the multiplier, the total product, 505885348005, will appear under the holes *c*, and the figures of the multiplier, viz. 6583, will appear in the holes *d*.

In division the operation is as simple as for multiplication, and is performed as follows: thus, to divide 414591904 by 4768, set up the dividend on the plate B, and the divisor on the plate A, commencing with the unit figure in each case to the right hand; place the knob E at Subⁿ and Divⁿ, and move the plate B to the right until the second figure (from the left) of the dividend is over the first figure (4) of the divisor; turn the handle eight times, and 8 will appear in the quotient holes *d*, and will give the first figure of the quotient, while the dividend will now show 33151904, having been reduced by eight times the divisor, as in ordinary arithmetic; move the plate B one place to the left, and turn the handle six times for the second figure of the quotient, and the dividend will be further reduced by six times the divisor, and will mark 4543904; again move the plate, and turn the handle nine times, and after moving the plate B, and turning the handle five times and three times respectively, the holes *c* will all show noughts, and the quotient holes *d*

will show 86953, which is the quotient required; if there had been any remainder, it would have appeared in the holes *c*.

Although by the ordinary limits of the machine a product of 16 places of figures and a quotient of 9 places of figures only can be obtained, yet by an intermediate record by the operator these limits may be virtually doubled for multiplication; while for division, provided the divisor does not exceed eight places of figures, the dividend and the quotient may be unlimited.

The use of the arithmometer in actuarial and other calculations has been shown in the papers read by Major-General Hannington and Mr. Peter Gray, F.R.A.S., F.R.M.S., respectively at the Institute of Actuaries (see the Journal of the Institute of Actuaries, p. 224, vol. xvi., and p. 249, vol. xvii.); and Mr. Thomas T. P. Bruce Warren, in a paper read before the Society of Telegraph Engineers, has shown the application of the instrument to electrical computations.

The Arithmometer is now, we believe, used in many Government Offices, in nearly all the Life Insurance Offices in England, in several Observatories; Sir W. Thompson, Prof. Tait, Prof. Galbraith, and Dr. Ball, also use them in the Universities and Colleges with which they are respectively connected.

The instrument can be seen, and all information obtained, of Mr. W. A. Gilbee, of 4, South Street, Finsbury, who, we understand, is sole agent for the Arithmometer.